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Optimization of static contact pressure for frictional contact problems

H. Kristiansen[1], N. Aage[2] and K. Poulios[3]

[1,2,3] Technical University of Denmark, Department of Mechanical Engineering, Solid Mechanics, Niels Koppels All, B. 404 DK-2800 Lyngby Denmark.
[1]Email: Hakris@mek.dtu.dk
[2]Email: Naage@mek.dtu.dk
[3]Email: Kopo@mek.dtu.dk

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This work aims to demonstrate a unification of density based topology optimization and frictional contact mechanics; a topic in which the available literature is very limited. We propose a cost function that may be used to control the distribution and variation of the contact pressure on a priory unknown interface region between a linear elastic domain and a rigid obstacle.

The solutions rely on a frictional semi-smooth contact model that is used to obtain normal and tangential contact forces. A robust density based topology optimization scheme is used together with the proposed objective function to find structures that experience a somewhat uniform contact pressure where two structures meet.

Two test problems are demonstrated in this work. For both problems, we seek topologies that experience uniform contact pressure in the contact region. Problem (1): A L-shaped domain which is pressed vertically towards a rigid obstacle. Friction is omitted in this example. Problem (2) A "bike brake" problem (the full-L problem). Friction forces are included, and accounted for, in this example.

The work concludes that it is possible to combine density based topology optimization with frictional contact mechanics and obtain crisp black and white designs in frictional problems. The proposed measure of uniformity in the contact pressure is well suited as an objective function to topology optimization.

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